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Clinical and radiological outcome of Matrix induced autologous chondrocyte implantation (MACI®) after 24 months

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Purpose: The objectives of this study was to evaluate the clinical outcome and the safety of MACI® in consecutive patients treated for symptomatic articular cartilage defects of the knee joint at different times (2 weeks, 1 month, 3 months, 6 months, 12 months and 24 months) post implantation.
Methods and Materials: This study was a prospective, monocenter, cohort study and 21 patients (85.7% males, 14.3% females; mean age 35.18 years) were followed for 24 months. The defects were localized on femoral condyles (76.2%) and on the patella (23.8%) with a mean defect size of 5.1 cm^2 (SD=2.1). All defects were treated with autologous chondrocytes seeded on a collagen Type I/III membrane (MACI®). The clinical outcome was determine with standard scores (ICRS) and the radiological morphology using high resolution magnetic resonance imaging (MRI) and the MOCART score.
Results: With the IKDC objective scoring system at 24 months a normal or nearly normal knee was found in 76.2%. The Lysholm score increased from 54.7 after the knee injury to 83.8 after 24 months ($p<.001$). The level of Tegner's sport activity increased from 23.1 to 63.6 ($p<.001$). In the MRI evaluation 24 months after implantation 88% of femoral grafts were completely present and in position. No product-specific adverse events were recorded.
Conclusions: Based on the results obtained, we conclude that MACI® is a successful and safe therapeutic option for the treatment of cartilage lesions of the knee, in particular traumatic lesions of the femoral condyle.

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Correlation of MRI to clinical outcome scores after autologous chondrocyte transplantation: MOCART (Magnetic Resonance Observation of CArtilage Repair Tissue) grading and scoring system

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Purpose: Matrix associated autologous chondrocyte transplants (MACT's) are implanted in the debrided cartilage defect without the use of a periosteal flap or further surgical fixation. A sufficient attachment is essential for the successful use and detachment of the graft may lead to treatment failure. To determine the adherence rate of the CaReS® technique we performed high resolution magnetic resonance imaging (MRI) in the early postoperative period.
Methods and Materials: Two years after matrix associated autologous chondrocyte transplantation (MACT), high-resolution MRI and a scoring system with nine variables was used to analyze the cartilage repair tissue (MOCART). The variables include filling of the defect, integration to cartilage and bone, surface, structure and signal intensity of the repair tissue, changes of subchondral lamina and bone, adhesion and effusion. Clinical scores were correlated with the MRI variables. Statistical analysis included Spearman correlation coefficient and student's t-test.
Results: A complete filling of the defect was found in 83.5%, and a complete integration of the border zone to the adjacent cartilage in 86.9%. An intact subchondral lamina was present in 84.6% and an intact subchondral bone was present in 71.5%. Isointense signal intensities of the repair tissue compared to the adjacent native cartilage were seen in 92.3%. A statistically significant correlation was found for the variables "filling of the defect," "structure of the repair tissue," "changes in the subchondral bone," and "signal intensities of the repair issue."
Conclusions: High resolution MRI and well-defined MRI variables is a reliable, reproducible, and accurate tool for assessing cartilage repair tissue.

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Postoperative adherence of matrix associated autologous chondrocyte transplantation of a three-dimensional collagen gel (CaReS®)

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Purpose: Matrix associated autologous chondrocyte transplants (MACT's) are implanted in the debrided cartilage defect without the use of a periosteal flap or further surgical fixation. A sufficient attachment of the graft is essential and detachment may lead to treatment failure. To determine the adherence rate of the CaReS® technique we performed high resolution magnetic resonance imaging (MRI) in the early postoperative period.
Methods and Materials: This study was a prospective, monocenter, cohort study and 25 patients (60% males, 40% females; mean age 29.7 years) were included. Only femoral, fill-thickness cartilage defects(lateral 48% and medial 52%; mean defect size: 5,5cm^2) were treated with a three-dimensional Collagen type I gel with cultivated autologous chondrocytes (CaReS®). The defects were debrided without violating the subchondral bone and a stable containment of healthy cartilage was obtained. The grafts were fixed only with fibrin glue (Tissucol®). High resolution MRI was performed in all patients between day 25 and 35 after operation. The implants were graded as completely attached, partially attached or detached.
Results: In 92% a completely attached graft was found and the cartilage defect site was totally covered by the implanted construct and repair tissue. In 8% a partial attachment occurred with partial filling of the cartilage defect. A complete detachment of the graft was not observed.
Conclusions: The implantation and fixation of a collagen gel with autologous chondrocytes (CaReS®) in a full thickness cartilage defect of the femoral condyle only with fibrin glue and with no further surgical fixation leads to a high attachment rate in the postoperative period.

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Morphological analysis of biopsies after MACT (Hyalograft®C)

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Purpose: Despite the matrix associated autologous chondrocyte transplantation (MACT) has been applied for more than one decade, we still have little experience in the biological characteristics of the repair tissue after MACT in patients. In the present study biopsies of MACT-patients were analysed in order to describe the cell and matrix properties of the repair tissue.
Methods and Materials: Twelve biopsies of different defect regions taken 1 to 1.5 years after a MACT with a hyaluronan matrix (Hyalograft®C) were analysed by histochemical, immunhistochemical and ultrastructural methods.
Results: Biopsies showed regeneration tissue of various qualities. Differentiated samples strongly resembled native cartilage, containing collagen type II, a high amount of proteoglycan and differentiated chondrocytes. The cement line was continuous and the tissue surface smooth. In contrast, fibrous tissue mainly consisted of collagen type I strands forming a three-dimensional meshwork without a significant amount of proteoglycan. Despite the undifferentiated matrix, cells frequently had a differentiated morphology and formed chondrons. Differences in repair tissue quality were evident between the patients but also between the biopsies of different defect regions of a single patient.
Conclusions: The morphological analysis of the biopsies confirmed the initiation of hyaline cartilage formation after Hyalograft®C implantation. Less differentiated samples showed a fibrous matrix with morphologically differentiated chondrocytes. In these cases the chondrocyte morphology was not correlated with collagen type II and proteoglycan synthesis. Failure of hyaline matrix formation is supposed to refer to a physiologically non-differentiated stage of morphologically differentiated chondrocytes.